A57 Link Roads

TR010034

6.3 Environmental Statement

Chapter 9 Geology and Soils

APFP Regulation 5 (2)(a)

Planning Act 2008 Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

March 2022

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A57 Link Roads Scheme

Development Consent Order 202[x]

6.3 Environmental Statement

Chapter 9 Geology and Soils

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9. Geology and Soils

9.1 Introduction

9.1.1 This chapter has been prepared to identify the likely effects with respect to geology and soils resulting from the Scheme. This Chapter assesses the potential environmental effects from the Scheme to geology and soils as outlined in DMRB LA109 Geology and soils[1] standard for assessing and managing the:

- Effects on bedrock geology and superficial deposits, including geological designations and sensitive/valuable non-designated features
- Effects on soil resources
- Effects from contamination on human health, surface water and groundwater.

9.1.2 The assessment of soil resources includes the identification of agricultural soils and agricultural land classification (ALC) of farmland affected by the Scheme. Assessment of impacts on the operation of agricultural holdings is provided in the Population and Human Health chapter (Chapter 13).

9.1.3 This chapter also provides an assessment of groundwater (hydrology and hydrogeology), with reference to DMRB LA113 Road drainage and the water environment[2]. This includes the potential for changes to groundwater levels and quality, as a result of the Scheme's impact on physical geological and hydrological regimes. The effects associated with groundwater on flooding, as well as the supporting modelling information are provided in the Road Drainage and the Water Environment chapter (Chapter 13). The effects associated with hydrological conditions (including surface water recharge) are also provided within Chapter 13.

9.1.4 This chapter identifies the existing baseline conditions, the method of the assessment, identifies the potential impacts on geology and soils associated with the Scheme during construction and operation and presents mitigation measures that are recommended for any potentially significant adverse effects.

9.1.5 This chapter utilises baseline information previously collected during the preliminary design stages associated with the Scheme and where applicable obtains more recent data or assesses the effects of the available data given the Scheme changes overtime.

9.2 Legislative and Policy Framework

9.2.1 This assessment has been undertaken in accordance with the following current legislation, along with national, regional and local plans and policies (further detail can be found in Section 1.3 of the Introduction chapter (Chapter 1), those specifically pertaining to geology and soils (including contaminated land) are summarised below.

[1] https://www.standardsforhighways.co.uk/dmrb/search/adca4c7d-4037-4907-b633-76eaed30b9c0
[2] https://www.standardsforhighways.co.uk/dmrb/search/d6388f5f-2694-4986-ac46-b17b62c21727

Legislation

9.2.2 The legislative framework applicable to this assessment is summarised as follows:

- Part 2A of the Environmental Protection Act (EPA) 1990 (Section 57 of the Environment Act 1995)[3]
- The Water Environment (WFD) (England and Wales) Regulations 2017[4]
- Construction (Design & Management) Regulations 2015 (CDM Regulations)[5].

9.2.3 Part 2A of the Environmental Protection Act 1990 (section 78A (2)) defines contaminated land any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:

(a) significant harm is being caused or there is the significant possibility of such harm being caused; or

(b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused

9.2.4 Part 2A requires all local authorities to identify contaminated land in its area and secure its remediation to a condition suitable for its use. A key element of the Part 2A regime is the Source-Pathway-Receptor contaminant linkage concept. Each element is defined as follows:

- The source is the contamination in, on or under the land.
- The pathway is the route by which the contaminated land reaches the receptor; and
- The receptor is defined as living organisms, ecological systems or property which may be harmed.

9.2.5 Without the clear identification of all three elements of the contaminant linkage, land cannot be identified as contaminated land under the regime.

9.2.6 The Contaminated Land regime, as implemented through EPA 1990 Part 2A and the planning regime, does not address the risks to construction or maintenance workers or other occupations which may have direct exposure to land contamination. The risks to these human receptors should be managed through health and safety legislation and are required to be reported as per GG 104[6] in line with CDM Regulations.

9.2.7 The Water Framework Directive (WFD) implements goals to improve water quality (surface water and groundwater) and drives sustainable use of water. The WFD has been utilised to aid in the identification of key controlled waters receptors.

[3] Department for Environment Food & Rural Affairs; Environmental Protection Act 1990: Part 2A; Contaminated Land Statutory Guidance; 2012
[4] Water Framework Directive (WFD); The Water Environment (WFD) England and Wales) Regulations 2017; 2017
[5] Health and Safety Executive; Managing Health and Safety in Construction; The Construction (Design and Management) Regulations 2015; 2015
[6] Highways England, GG 104 Requirements for safety risk assessment (formerly GD04/12 and IAN 191/16) Design Manual for Roads and Bridges, Revision 0, June 2018

National Planning Policy

9.2.8 National Planning Policy comprises:

- The National Policy Statement for National Networks (NPS NN) 2014[7].
- The National Planning Policy Framework (NPPF) 2019[8]

9.2.9 The NPS NN sets out the need for, and Government's policies to deliver, development of NSIPs on the national road and rail networks in England in relation to geology and soils for the following:

- Pollution control and other environmental protection regimes
- Biodiversity and ecological conservation which includes geological conservation
- Land stability
- Water quality and resources including physical characteristics of the water environment plus quantity and dynamics of flow
- Land use including open space, green infrastructure and Green Belt pertaining to Agricultural Land Classification (ALC), soil quality and consideration of the risk posed by land contamination and how it is proposed to address this.

9.2.10 Paragraph 5.176 of the NPS NN advises that the economic and other benefits of the best and most versatile agricultural land should be taken into account and little weight will be attached to the loss of agricultural land in grades 3b, 4 and 5.

9.2.11 Paragraph 5.219 of the NPS NN advises that infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction and operation, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. The Government's planning policies make clear that the planning system should contribute to and enhance the natural and local environment by, amongst other things, preventing both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution.

9.2.12 Paragraph 170 of the NPPF is of particular relevance to geological and soil conservation, stating that policies and decisions should contribute to and enhance the natural and local environment by 'protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan)' as well as recognising the 'economic and other benefits of the best and most versatile (BMV) agricultural land, and of trees and woodland.'

9.2.13 Furthermore, paragraph 170 outlines the importance of the character of the countryside and its wider benefits, including the 'economic and other benefits of the BMV agricultural land, and of trees and woodland.'

9.2.14 Paragraph 170 also states that plans should prevent 'new and existing development from contributing to, being put at unacceptable risk from, or being

[7]National Policy Statement for National Networks (Department for Transport, 2014) ttps://www.gov.uk/government/publications/national-policy-statement-for-national-networks Viewed Nov 2020
[8]National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2019 https://www.gov.uk/government/publications/national-planning-policy-framework--2 Viewed Nov 2020

adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.'

9.2.15 Paragraph 178 of the NPPF, confirms how contaminated land issues are a material consideration during development pertaining to suitability for its proposed use taking account of ground conditions and any risks arising from land instability and contamination, after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990; and adequate site investigation information, prepared by a competent person, is available to inform these assessments.

9.2.16 Paragraph 179 of the NPPF states where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

Regional and Local Policy

9.2.17 The Tameside Unitary Development Plan 2004[9] (In absence of the Local Plan in preparation) is a land use planning document which provides a framework for development and conservation over the whole of the Tameside area. The main policies relating to geology and soils are:

- OL11 support for agriculture
- MW10 development on or near landfill sites
- MW11 contaminated land
- MW12 control of pollution
- MW15 protection of water resources

9.2.18 The Open Land policy (OL) 11 states that where development of agricultural land is unavoidable, the Council will seek to encourage the use of poorer quality land in preference to that of higher quality, except where other sustainability considerations suggest otherwise.

9.2.19 The High Peak Local Plan[10], 2016 sets out the policies for development of land. The main policies relating to geology and soils are:

- EQ10 Pollution Control and Unstable Land

9.2.20 This plan recognises the contribution of soils to landscape character and biodiversity but does not provide specific protection to agricultural soils.

9.2.21 Peak District National Park Local Development Framework - Core Strategy Development Plan Document, 2011. The main policies relating to Geology and Soils are:

- L2: Sites of biodiversity or geodiversity importance

Guidance

9.2.22 A detailed technical framework for investigating and dealing with land affected by contamination is contained within the Environment Agency's Land Contamination Risk Management (LCRM) guidance.

[9]Tameside Unitary Development Plan. Adopted 2004 https://tameside.gov.uk/udp/writtenstatement.pdf Viewed Nov 2020
[10] The High Peak Local Plan. Adopted 2016 https://www.highpeak.gov.uk/article/646/The-Adopted-Local-Plan-2016 Viewed Nov 2020

9.2.23 The following additional guidance documents relevant to geology and soils (including the assessment of land contamination) have been considered when undertaking this assessment:

- The Design Manual for Roads and Bridges (DMRB), Highways England LA104, LA109 and LA113
- Construction Industry Research and Information Association (CIRIA) C552 – Contaminated Land Risk Assessment – A Guide to Good Practice 2001[11]
- CIRIA C665 – Assessing Risks Posed by Hazardous Ground Gases to Buildings, 2007[12]
- CIRIA C733 – Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks, 2014[13]
- CIRIA C682 – The Volatile Organic Contaminants (VOCs) Handbook, 2009[14]
- British Standard (BS) 10175:2011+A2:2017. Investigation of potentially contaminated sites. Code of practice. 2017[15]
- BS 21365:2020 – Soil quality – Conceptual site models for potentially contaminated sites. 2020[16]
- BS 5930:2015 + A1:2020. Code of practice for ground investigations. 2020[17]
- BS 8485:2015+A1:2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings 2019[18]
- Contaminated Land: Applications in Real Environments (CL:AIRE) Code of Practice Definition of Waste: Code of Practice (CoP)[19].
- Code of Practice for the Sustainable Management of Soils on Construction Sites (Defra, 2009)[20]
- Tameside MBC Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Landowners and Consultants, Version 2.3 July 2020.[21]
- Developing land within Derbyshire, A guide to submitting applications for land that may be contaminated, Version 4 – March 2010[22].

9.2.24 The following guidance has been utilised in association with the assessment of soil resources:

[11] Construction Industry Research and Information Association (CIRIA); Contaminated Land Risk Assessment. A Guide to Good Practice (C552); 2001
[12] CIRIA; Assessing Risks Posed by Hazardous Ground Gases to Buildings (C665); 2007
[13] CIRIA; Asbestos in Soil and Made Ground. A Guide to Understanding and Managing Risks (C733); 2014
[14] CIRIA; The Volatile Organic Contaminants (VOCs) Handbook (C682); 2009
[15] British Standards (BS); BS 10175:2011+A2:2017. Investigation of potentially contaminated sites. Code of Practice; 2017
[16] BS; BS EN ISO 21365:2020. Soil quality – Conceptual site models for potentially contaminated site; 2020
[17] BS; BS5930:2015+A1:2020. Code of practice for ground investigations; 2020
[18] BS; BS8485:2015+A1:2019; Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings; 2019
[19] Contaminated Land: Applications in Real Environments (CL:AIRE); Code of Practice Definition of Waste: Code of Practice (CoP);
[20] DEFRA; Code of Practice for the Sustainable Management of Soils on Construction Sites; 2009
[21] Tameside MBC Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Land Owners and Consultants, Version 2.3 July 2020
[22] Developing land within Derbyshire, A guide to submitting applications for land that may be contaminated, Version 4 – March 2010

- Technical Information Note 049 (TIN049). Agricultural Land Classification: protecting the best and most versatile agricultural land (Natural England, 2012)[23]
- Safeguarding our Soils – A Strategy for England (Defra, 2009)[24]

9.2.25 TIN049 states that for planning applications, specific consultations with Natural England are required under the Town and Country Planning (Development Management Procedure) Order (UK Government, 2010) in relation to developments affecting not less than 20 ha of BMV agricultural land. This assessment concludes there is no BMV in the study area or the wider vicinity.

9.2.26 The safeguarding our soils strategy states that by 2030, Defra's vision is that all of England's soils will be managed sustainably and degradation threats tackled successfully. Chapter 6 of the strategy states objectives for effective soil protection during construction and development are to; ensure soil ecosystems services are fully valued in the planning process; ensure appropriate consideration is given to the protection of good quality agricultural soils from development; and encourage better management of soils through all stages of the construction process.

9.2.27 Paragraph 8.53 of the Greater Manchester Spatial Framework (GMSF). Draft for approval, Oct 2020[25] states that agricultural land is also of significance in the safeguarding of soil resources, with 'best and most versatile' land safeguarded because of its long-term potential for delivering both food and non-food crops. Soils in Greater Manchester are, however, significant for more than their agricultural value with extensive uplands and lowland areas characterised by deep peaty soils, which have a high environmental value and are identified as a priority in the Government's 25-year environment plan[26]. Neither of these provisions is relevant to the Scheme as there is no BMV land and no deep peaty soils.

9.3 Assessment Methodology

Consultation and scoping responses

9.3.1 Details of consultation undertaken to inform the Geology and soils assessment are presented in the Introduction chapter (Chapter 1) (Table 1-6) and the Consultation Report (TR010034/APP/5.1).

9.3.2 An overview of the Planning Inspectorate's Scoping Opinion on the proposed scope of the Geology and soils assessment is provided in Appendix 4.1 (document reference TR010034/APP/6.5). Any additional consultation responses or changes to assessment methodology due to the latest DMRB standards or design changes are also detailed in Appendix 4.4 (document reference TR010034/APP/6.5).

[23]Natural England (2012), Technical Information Note 049: Agricultural Land Classification: protecting the best and most versatile agricultural land http://publications.naturalengland.org.uk/publication/35012 Viewed Nov 2020
[24]Safeguarding our Soils – A Strategy for England (Defra, 2009) https://www.gov.uk/government/publications/safeguarding-our-soils-a-strategy-for-england Viewed Nov 2020
[25]Greater Manchester Spatial Framework. Draft for approval, Oct 2020, GMSF – Publication Plan 2020 (greatermanchester-ca.gov.uk) Viewed Nov 2020
[26] HM Government, A Green Future: Our 25 Year Plan to Improve the Environment, 2018

Approach to methodology and assessment

9.3.3 The assessment in relation to geology and soils has accounted for the Scheme design, study area and the assessment methodology in accordance with DMRB LA109 and DMRB LA113 with the significance of effects in accordance with DMRB LA104[27].

9.3.4 No element has been scoped out of this assessment.

9.3.5 Assessment for geology and soils also takes into account contaminated land risk using the Environment Agency Land Contamination Risk Management (LCRM) guidance[28] and the WFD based on a source, pathway, receptor approach associated with the collection of baseline information and the sensitivity of identified receptors.

9.3.6 Baseline information has been gathered by:

- Identifying an appropriate study area
- Review of previous reports including desk-based assessments, ground investigation (GI) data (Ground Investigation Report (TR010034/APP/7.6)) and water features survey, details of which are summarised within the Road drainage and the water environment chapter (Chapter 13)
- Review of information provided during consultation (Please refer to Table 1-6 within the Introduction chapter (Chapter 1) and the consultation report TR010034/APP/5.1 for a consultation overview) with the Local Authorities' Environmental Protection Departments and the Environment Agency
- A review of previous reports pertinent to the groundwater regime, details of which are summarised in the Road Drainage and the Water Environment chapter (Chapter 13).

9.3.7 The value of the identified receptors/resources has been assessed against the criteria shown in Table 9-1 below.

Table 9-1 Environmental value (sensitivity) and descriptions for Geology and Soils

Receptor Value (sensitivity)	Description
Very High	Geology: very rare and of international importance with no potential for replacement (UNESCO World Heritage Sites, SSSI's, etc). Soils: 1. soils directly supporting an EU designated site (e.g. SAC, SPA, Ramsar); and/or 2. ALC grade 1 & 2 Contamination: 1. Human health – very high sensitivity land use such as residential or allotment land use 2. Surface water – WFD classification high, designated sites such as Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Source Protection Zone (SPZ), Ramsar site, salmonid water

[27] https://www.standardsforhighways.co.uk/dmrb/search/78a69059-3177-43dc-94bd-465992cfda82
[28] Environment Agency; Land Contamination Risk Management (LCRM). How to assess and manage the risks from land contamination; 2020. https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

Receptor Value (sensitivity)	Description
	3. Groundwater – Principal aquifer, SPZ1
High	Geology: rare and of national importance with little potential for replacement (geological SSSI's, ASSI, NNR). Geology meeting national designation citation criteria which is not designated as such. Soils: 1. soils directly supporting a UK designated site (SSSI); and/or 2. ALC grade 3a Contamination: 1. Human Health –high sensitivity land use such as public open space land use 2. Surface water – WFD Class 'Good', Major Cyprinid Fishery, Species protected under EC or UK habitat legislation. 3. Groundwater – Principal Aquifer, SPZ2
Medium	Geology: of regional importance with limited potential for replacement (RIGs). Geology meeting regional designation citation criteria which is not designated as such. Soils: 1. soils supporting non-statutory designated sites (LNR, LGS's, SNCI's); and/or 2. ALC grade 3b Contamination: 1. Human Health – medium sensitivity land use such as commercial and/or industrial land use 2. Surface water – WFD class "moderate" 3. Groundwater – Aquifer providing water for agricultural or industrial use with limited connection to surface water, SPZ3
Low	Geology: of local importance/interest with potential for replacement (non-designated geological exposures, former quarry's) Soils: 1. coils supporting non-designated notable or priority habitats; and/or 2. ALC grade 4 & 5 Contamination: 1. Human Health – low sensitivity land use such as highways and rail land use 2. Surface water – WFD classification "poor". 3. Groundwater – Unproductive strata
Negligible	Geology: no geological exposures, little/no local interest. Soils: previously developed land formerly in 'hard uses' with little potential to return to agriculture. Contamination: 1. Human health – undeveloped surplus land/no sensitive land use proposed. 2. Surface water – WFD classification "poor". 3. Groundwater - Unproductive strata

9.3.8 The approach outlined below has been followed to identify mitigation measures and assess likely residual effects to geology and soils receptors:

- Consideration of best practice/guidance

- Professional judgement
- Consideration of baseline information obtained, Scheme design details and issues raised through consultation with interested parties as a result of responses to the Preliminary Environmental Information Report (PEIR)[29] and statutory consultation. More details on this consultation can be found within Table 1-6 in the introduction chapter (Chapter 1) and in the Consultation Repot (TR010034/APP/5.1)
- Consideration of potential future baseline
- Identification of appropriate mitigation measures and/or embedded design features.

9.3.9 Magnitude of impacts have been described using the criteria outlined in Table 9-2.

Table 9-2 Magnitude of impact and typical descriptions for Geology and Soils

Magnitude of Impact	Typical description
Major	Geology: Loss of geological feature/designation and/or quality and integrity, severe damage to key characteristics, features or elements. Soils: Physical removal or permanent sealing of soil resource or agricultural land. Contamination: 1. Human health – significant contamination identified. Contamination levels significantly exceed background levels and screening criteria with potential for significant harm to human health. Contamination heavily restricts future use of land. 2. Surface water – Compliance failure with environmental quality standards (EQS), loss or extensive change to a fishery, loss of regionally important public water supply, loss or extensive change to a designated nature conservation site, reduction in water body WFD classification. 3. Groundwater – loss of or extensive change to aquifer, loss of regionally important water supply, loss or significant damage to major structures through subsidence or similar effects, high risk of pollution of groundwater.
Moderate	Geology: Partial loss of geological feature/designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Soils: Permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource.) Contamination: 1. Human Health – contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria. Significant contamination can be present. Control/remediation measures are required to reduce risks to human health/make land suitable for intended use.

Magnitude of Impact	Typical description
	2. Surface water – Partial loss in productivity of a fishery, degradation of regionally important public water supply, contribution to reduction in WFD classification. 3. Groundwater – Partial loss or change to an aquifer, degradation of regionally important public water supply, potential of medium risk of pollution to groundwater, contribution to reduction in WFD classification, damage to major structures through subsidence.
Minor	Geology: Minor measurable change in geological feature/designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Soils: Temporary loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource.) Contamination: 1. Human Health – contaminant concentrations are below relevant screening criteria. Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health 2. Surface water – Minor effects on water supplies 3. Groundwater – potential low risk of pollution to groundwater, minor effects on an aquifer, abstractions and structures.
Negligible	Geology: Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature/designation. Overall integrity of resource not affected. Soils: No discernible loss/reduction of soil function(s) that restrict current or approved future use. Contamination: 1. Human health – contaminant concentrations substantially below relevant screening criteria. No requirement for control measures to reduce risks to human health/make land suitable for intended use. 2. Surface water – No risk identified. Risk of pollution low. 3. Groundwater – no measurable impact upon an aquifer and/or groundwater receptors.
No Change	Geology: No temporary or permanent loss/disturbance of characteristics, features or elements. Soils: No loss/reduction of soil function(s) that restrict current or approved future use. Contamination: 1. Human Health – reported contaminant concentrations below background levels. 2. Surface water and groundwater – no loss or alteration of characteristics, features or elements; no observable impact.

9.3.10 The determination of the significance of the impact is a factor of the value of the feature/resource (receptor) and the magnitude of the impact (change). The

significance categories used within this chapter are those as outlined within the significance matrix contained within DMRB LA 104 (reproduced in Table 4-3 within the Environmental assessment methodology chapter (Chapter 4)).

9.3.11 The assessment of the significance of residual effects will consider possible mitigation measures.

9.3.12 In accordance with DMRB LA 109, where two potential values of significance of effect are identified using DMRB LA 104's significance matrix professional judgement is used to assign the value based on understanding of details of both the magnitude of impact and value of the receptor. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement will be used to determine whether this results in a slight or moderate effect. In general, moderate to very large effects are to be considered significant in terms of the EIA regulations.

Land Stability

9.3.13 The NPS NN states that where necessary, land stability should be considered in respect of new development, as set out in the National Planning Policy Framework.

9.3.14 Land stability associated with geological conditions and mining hazards are assessed though DMRB CD622 Managing Geotechnical Risk [30] and are not assessed in terms of environmental impact in accordance with DMRB LA109. The changes in the scope of the assessment as a result of the recent DMRB updates are further detailed in Appendix 4.4 (TR010034/APP/6.5).

Unexploded Ordnance (UXO)

9.3.15 The risks posed to the site by unexploded ordnance (UXO) are assessed through DMRB GG 104 Requirements for Safety Risk Assessment and are not assessed in terms of environmental impact in accordance with DMRB LA 109.

9.4 Study Area

9.4.1 A detailed description of the Scheme is provided within The Scheme chapter (Chapter 2).

9.4.2 The study area for the existing environmental conditions comprises up to a 250 m buffer from the Development Consent Order (DCO) boundary[31]. The baseline information covers the Scheme and the study area; and where relevant in the identification of sensitive receptors, is increased to between 500 m to 1 km. The buffer associated with hydrogeological (groundwater) receptors is 1 km. Based on professional judgement we consider that the study area outlined above will adequately identify any key sensitive receptors. Please refer to Figure 9-1 which shows the DCO and study area for this assessment.

9.4.3 The study area for agricultural soils and ALC is the DCO boundary and includes compounds and temporary land take. This area comprises 60 Ha as shown on Figure 2.1 DCO boundary (TR010034/APP/6.4).

[30] Highways England, CD 622 Managing Geotechnical Risk (formerly HD 22/08, BD 10/97, HA 120/08) Design Manual for Roads and Bridges, Revision 1, March 2020
[31] This boundary shows the limits within which works associated with the Scheme may be carried out. This includes the land required permanently and temporary for the operation and construction of the Scheme.

9.5 Assessment Assumptions and Limitations

9.5.1 The PSSR (desk-based study) (Arcadis, June 2017) has been provided as an appendix to this chapter (Appendix 9.1, TR010034/APP/6.5). The main findings of the PSSR have been summarised by the Applicant within the GIR. The GIR has been provided as standalone report as part of this application (TR010034/APP/7.6).

9.5.2 This Geology and soils chapter includes reference to the sustainable reuse of soils pertaining to land contamination effects and should be read in conjunction with the Mineral assets and waste chapter (Chapter 10).

9.5.3 The contaminated land assessment also takes into consideration any ecological sensitive receptors identified in the Biodiversity chapter (Chapter 8). At present, significant ecologically sensitive designated receptors have not been identified.

9.5.4 As with risk-based assessments of ground conditions, emphasis is placed on the analyses which have been undertaken according to established guidance. However, it should be noted that there may be areas, particularly away from and between exploratory holes where unfavourable ground conditions, if encountered, may require further assessment.

9.5.5 A number of key design changes have been made to the Scheme during the preliminary design stage, further details on these specific changes are provided within Table 3-7 of the Assessment of Alternatives chapter (Chapter 3).

9.5.6 The elements of the geology and soils assessment that these design changes affect is in relation to the areas of excavation and reuse of soils plus the creation of five new structures instead of four (Old Hall Farm underpass, Mottram Underpass, Carrhouse Lane underpass, River Etherow Bridge and Roe Cross Road Bridge). However, it should be noted that GIs previously undertaken across the former Scheme alignment are still considered relevant to the current Scheme/study area and the data obtained can be utilised in this assessment.

9.5.7 Soil information on which the ALC assessment is based is taken from published sources rather than a soil survey of the study area. This is because the soil conditions described in these sources are consistent with the geology and land use and so fieldwork would not have provided a useful amount of additional information for the ALC assessment.

9.5.8 To date, no Geology and Soils specific site walkover has been undertaken as part of this assessment, however, available online mapping and aerial images have been reviewed along with site photos collected during walkovers undertaken by other Chapters, and no significant sources of contamination identified.

9.5.9 Notwithstanding, any potential deviation, all geology and soils mitigation measures embedded in the design of the Scheme and described in Section 9.9 would still be deliverable within the limits of deviation and would still fulfil their intended function.

Further Ground Investigation

9.5.10 A supplementary GI commenced in February 2021, with a 12-week programme for completion. The Supplementary Ground Investigation Report

(TR010034/EXAM/9.71) for this investigation has been provided as a separate document to the DCO examination in March 2022.

9.5.11 The purpose of the supplementary GI was to provide information specific to the current Scheme and aid in the design process. The next phase of GI has been used to confirm the ground conditions previously encountered during previous investigations. The GI investigations included specifically targeted areas in relation to potential land contamination outlined in the Table below:

Table 9-3 Details of supplementary GIs to be undertaken

Location	Requirements	Exploratory Hole
Within vicinity of Carr House Lane landfill (potential source of contamination). To gather data within area between Scheme and suspected landfill location which was not previously investigated.	Soil samples, groundwater and ground gas.	BH541 TP523
Exploratory holes located within an area of a number of contemporary trade directories. Previous GIs recorded a marginals dibenz(ah)anthracene exceedance within a soil sample and minor TPH exceedances within groundwater samples collected within this area. Due to the creation of an enclosed space within the proposed underpass, further gas monitoring may be required. Further sampling/monitoring is required to confirm that no unacceptable risk is present.	Soil samples and groundwater samples. Ground gas (BH510 & BH513).	BH510 BH511 BH512 BH513 BH514 BH515
Previous GI recorded a lead exceedance within this area of the Scheme. Further samples required to confirm that this does not pose an unacceptable risk.	Soil sample and groundwater sample.	BH546
Exploratory holes located within proposed deep cuttings. Require deeper samples of soil due to the potential reuse of material across the Scheme. Previous GIs recorded heavy metal exceedances within groundwater but did not show a significant risk. More recent samples would be obtained from this area to provide confirmation of low risk.	Soil samples and groundwater samples	BH517 BH520 BH527 BH528
Previous GIs recorded exceedances of PAHs and TPH within the vicinity of this area within the groundwater. Exceedances were not found to pose an unacceptable risk; however, further samples are required to confirm this.	Soil and groundwater	BH504 BH503 or TP502

Location	Requirements	Exploratory Hole
To aid in the analysis of risk posed to controlled waters receptors and the calculation of bioavailable concentrations.	Surface Water Samples	River Etherow (upstream, centre and downstream)

9.5.12 Environmental soil samples were also collected from all exploratory holes planned to be undertaken for chemical analysis to assess suitability for reuse. Pump tests informed the understanding of groundwater conditions, particularly flows from the underpass/proposed cutting sides. Tests were undertaken at the following locations: BH514, BH519 and BH521. Following completion of the GI, post site work ground gas and groundwater monitoring were undertaken at selected exploratory holes.

9.5.13 The Scheme Design for DCO submission has been based on data gathered from previous phases of GI (APP/TR010034/7.6). It is not believed that the geology and/or ground conditions have significantly altered since assessments were undertaken in 2018, as confirmed by the supplementary GI, which validates assumptions and fills identified data gaps. The land to be developed has been used primarily as agricultural land or existing highway over this time period. The use or conditions of mines within the DCO boundary has also not thought to have altered during the two-year period. The additional data gathered as part of the 2021 GI described above is provided in a separate Supplementary Ground Investigation Report to support this DCO application in March 2022 (TR010034/EXAM/9.71). It will be utilised to support the later stages of design.

9.5.14 It is not considered that these limitations and/or assumptions have affected the ability to undertake the assessment nor the conclusions reported in this chapter.

9.6 Baseline Conditions

Introduction

9.6.1 The study area has been divided into areas to aid the summarising of geology into sections defined by key Scheme development features as illustrated on Figure 9.1.

9.6.2 The baseline in terms of geology and soils has been established from the following sources of information:

- A57/A628 Transpennine Upgrade Programme, Preliminary Sources Study Report (PSSR), Arcadis/Highways England, June 2017 (ref: HE551473-ARC-HGT-ZZZ-GE-2001) including information provided by Envirocheck provided within Appendix 9.1 (TR010034/APP/6.5).
- Trans-Pennine Upgrade (TR010034) Ground Investigation Report (GIR), Highways England, Rev V0.2.0, February 2019 (ref: HE551473-ARC-HGT-TPU-RP-CE-3199)[32] (TR010034/APP/7.6), provided as a standalone document, which includes a summary and refers to the following report:

[32] Highways England; Trans-Pennine Upgrade (TR010034) Ground Investigation Report (GIR) Rev V0.2.02019 (ref: HE551473-ARC-HGT-TPU-RP-CE-3199); 2019

  - Trans-Pennine Upgrade (TR010334) Coal Mining Report, Highways England, Rev V0.1.1, April 2019 (ref: HE551473-ARC-EGT-TPU-RP-LE-3213).

- Trans-Pennine Upgrade Water Features Survey, Highways England, Rev V0.2.0, April 2019
- Trans-Pennine Upgrade (TR010034) Groundwater Modelling Report, Highways England, Rev 0.2.0, April 2019 provided within Appendix 13.2 (TR010034/APP/6.5).
- Statutory and non-statutory pre-application consultations undertaken by the Applicant between 2018 and 2020 (included within Appendix 9.3 (TR010034/APP/5.1), as follows:
  - Environment Agency via Greater Manchester, Merseyside and Cheshire (GMMC), dated 26 April 2018 and 20 November 2020
  - High Peak Borough Council Environmental Search, dated 28 June 2018 (Re-contacted 5 November 2020, no response was received)
  - Tameside Metropolitan Borough Council Environmental Protection, dated 3 July 2018 and 24 November 2020.

9.6.3 The following has provided additional information to supplement the above in relation to the current Scheme:

- Review of online information, including the use of:
  - British Geological Survey Onshore Geoindex[33]
  - British Geological Survey Map Portal[34]
  - Department of Food and Environment Multi-Agency Geographical Information for the Countryside (MAGIC) online mapping[35]
  - JNCC Geological Conservation Review - https://jncc.gov.uk/our-work/geological-conservation/#the-geological-conservation-review
- Consultation with Tameside Council RIGS officer was undertaken on 13 October 2020, however no response was received
- Water features survey undertaken by the Applicant in 2020 as detailed in the Road drainage and the water environment chapter (Chapter 13); and
- A review of available information pertaining to agricultural soils:
  - Soil Survey of England and Wales (1983). Soils of England and Wales, Sheet 1 Northern England. Rothamsted Experimental Station[36].
  - Soil Survey of England and Wales (1984). Soils and their Use in Northern England. Rothamsted Experimental Station[37].
  - Ministry of Agriculture Fisheries and Food (MAFF) Agricultural Land Classification map North West England.

[33] British Geological Survey; GeoIndex Onshore; [redacted] Accessed November 2020
[34] BGS, Geological Survey of England and Wales; 1:63,360/1:50,000 geological map series, New series https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=listResults&MapName=&series=E50k&scale=&pageSize=100&getLatest=Y
[35] Defra; Multi-Agency Geographic Information for the Countryside (MAGIC) Online mapping; https://magic.defra.gov.uk/home.htm; accessed November 2020
[36]Soil Survey of England and Wales (1983), Soils of England and Wales, Sheet 1 Northern England. Rothamsted Experimental Station
[37]Soil Survey of England and Wales (1984). Soils and their Use in Northern England. Rothamsted Experimental Station

http://publications.naturalengland.org.uk/category/5954148537204736, Viewed August 2020[38].

- Ministry of Agriculture, Fisheries and Food (1988), Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land[39].
- http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf, Viewed August 2020[40].
- Natural England (2012), Technical Information Note 049: Agricultural Land Classification: protecting the best and most versatile agricultural land http://publications.naturalengland.org.uk/publication/35012, Viewed August 2020[41].
- Cranfield Environment and Agrifood, Landis Soilscapes Viewer[42].

Published Geology

9.6.4 The GIR (TR010034/APP/7.6) which provides a summary of the geological review discussed within the Preliminary Sources Study Report (PSSR), and British Geological Survey (BGS) 1:50,000 scale geological maps (Sheet 86 Glossop and Sheet 87 Barnsley) show that superficial Devensian Till (gravel, sand and clay) underlies the majority of the study area. In the eastern portion of the study area, the presence of Head (clay) deposits, Alluvium (clay, silt, sand, peat and basal gravel) with an area of River Terrace Deposits (sand and gravel) associated with the River Etherow area mapped. Bedrock beneath the superficial deposits comprises lithologies of the Millstone Grit Group and varies along the route and across the study area comprising:

- Hebden Formation (Mudstone and Siltstone)
- Lower Kinderscout Grit (Sandstone)
- Fletcher Bank Grit (Sandstone)
- Marsden Formation (Mudstone and Siltstone)
- Huddersfield White Rock (Sandstone)
- Rossendale Formation (Mudstone and Siltstone)
- Marsden Formation (Mudstone and Siltstone)
- Huddersfield White Rock (Sandstone).

9.6.5 Two fault lines are mapped to be crossing the Scheme. The first fault trends north-east to south-west and is positioned across the A57, west of the existing M67 roundabout at the western extent of the Scheme. The other fault, the Mottram Fault (Arcadis, 2019), crosses the location of the proposed Mottram

[38]MAFF, Agricultural Land Classification map North West England. http://publications.naturalengland.org.uk/category/5954148537204736 Viewed Nov 2020
[39]Ministry of Agriculture, Fisheries and Food (1988), Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land. http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf Viewed Nov 2020
[40]Department for Environment, Food and Rural Affairs (2009), Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites Viewed August 2020
[41] Natural England (2012) Technical Information Note 049. *Agricultural Land Classification: protecting the best and most versatile agricultural land*. [redacted] Viewed August 2020.
[42] Cranfield Environment and Agrifood, Landis Soilscapes [redacted] Viewed August 2020

Underpass running north west to south east with Marsden Formation on the south west side and Fletcher Bank Grit or Sandstone on the north east side.

9.6.6 An additional fault is mapped crossing the most northern section of the study area but in a north east to south west direction. Within the study area other fault lines are mapped to the west and south of the Scheme.

Designated Geological Sites

9.6.7 Information from the JNCC Geological Conservation Review and MAGIC website (www.magic.gov.uk) indicates that there are no recorded geodiversity heritage sites, Regionally Important Geology Sites (RIGS) or geological SSSIs within 1 km of the Scheme. The Tameside RIGS Officer was contacted on 13 October 2020 to gain confirmation on this however no response has been received.

Coal Mining and Mineral Deposits

9.6.8 The Scheme and study area are within a coal mining affected area.

9.6.9 The Coal Authority Report indicates that there are two mine entries on, or within 20 m of the boundary of the Scheme, towards the south west. Details in the available GIR indicates that the risk of shallow coal mining is low, and the two mining entries shown relate to the Longdendale aqueduct airshaft. The Longdendale pipeline is a water supply pipeline from a reservoir source.

9.6.10 Although the Coal Authority reported the potential for shallow seams beneath the Scheme, none of the past GIs encountered evidence of workable seams. Since the only deep cutting and associated deep foundations are proposed away from identified shafts on the boundary of the Scheme, it is improbable that coal seams would be encountered. Therefore, the presence of coal measures or past mining are not anticipated to significantly influence the Scheme, including the presence of mine water.

9.6.11 From the Landmark Environmental Database discussed in the PSSR and summarised in the GIR, no mineral sites are indicated within the Scheme, the nearest mineral site being approximately 200 m from the Scheme.

9.6.12 From the Landmark Environmental Database discussed in the PSSR and summarised in the GIR, there are no natural cavities recorded along the Scheme; however, there may be unrecorded natural cavities present within the study area.

Encountered Geology

9.6.13 A number of GIs have taken place across the Scheme including:

- Socotec Ltd, 2018
- Furgo Engineering Services Ltd, 2005
- Norwest Holst Soil Engineering Ltd, 2004
- Soil Mechanics Ltd, 1995

9.6.14 A summary of the number of exploratory holes and relevant testing has been provided within Table 9-3 below. Exploratory hole locations previously undertaken are presented on Figure 9.1.

Table 9-4 Summary of exploratory holes and testing undertaken within each section of the Scheme

Section of Scheme (Refer to Figure 9.1, TR010034/APP/6.4)	No. of Boreholes	No of Trial Pits	No. of soils samples analysed	No. of groundwater samples analysed	Ground gas/ groundwater monitoring locations
M67 Junction 4 to Old Mill Farm Underpass (A)	21	13	15	0	0
Old Mill Farm Underpass (B)	0	1	0	0	2
Western Cutting (C)	9	6	13	2	0
Mottram Underpass (D)	46	0	16	1	5
Eastern Cutting (E)	17	8	9	2	2
Longdendale Aqueduct (F)	1	5		0	0
Mottram Moor Signal Controlled Junction (G)	5	9	4	1	2
Carrhouse Farm Underpass (H)	2	1	5	0	1
River Etherow Crossing and Brookfield Junction (I)	5	3	10	0	2
Eastern Embankments (J)	3	4	10	0	2

9.6.15 The GIR (TR010034/APP/7.6) provides details of the ground conditions encountered which is generally consistent with the anticipated published geology as previously summarised as given in Table 9-4 below.

Table 9-5 Summary of geology encountered during previous phases of GI

Section of Scheme (Refer to Figure 9.1)	Geology Encountered
M67 Junction 4 to Old Mill Farm Underpass (A)	Thin layer of topsoil (0.5 m thickness) which is described as slightly sandy Clay with rootlets. Predominately cohesive Glacial Till is encountered beneath topsoil which thins from west (26 m) to east (22 m) towards Mottram Underpass. This could be associated with a buried (superficial deposit filled) paleochannel. Till is described as soft to firm occasionally stiff to very stiff slightly sandy occasionally gravelly Clay. At the western extent, occasional pockets of alluvium are recorded to overlie the Glacial Till (1.8 m thickest) which is composed of soft sandy Clay, sand and peat with occasional organic soils. Granular Alluvium comprising sand was also recorded (1.80 m thickness). Bedrock was proven in two boreholes at the western end of the section of the main Scheme at depths of approximately 26 m bgl and comprised highly to slightly weathered, moderately strong to strong siltstone.
Old Mill Farm Underpass (B)	Topsoil (maximum 0.40 m thickness) described as slightly sandy Clay. Glacial Till was encountered to a maximum depth of 10.45 m bgl, where the borehole was terminated. Glacial Till was described as slightly sandy occasionally gravelly Clay. Bedrock was not encountered in this area.
Western Cutting (C)	Topsoil is present (0.4m thickness) over Glacial Till which thins out moving eastwards with an approximate thickness of 22m in the west to

Section of Scheme (Refer to Figure 9.1)	Geology Encountered
	14m at the eastern end of this section, potentially associated with the paleochannel. The Glacial Till is generally described as slightly sandy Clay. The upper layers towards the western extent have a gravelly component. Cohesive Alluvium, comprising sandy Clay with rare gravel, was found in one location (TP10). Bedrock beneath the Till is from the Millstone Grit group and is predominately very weak to moderately weak mudstone, overlain by a thin band (0.70 m) of strong sandstone. At the eastern end of the proposed cutting (near to Mottram Underpass) the bedrock is dominated by sandstone and siltstones.
Mottram Underpass (D)	The uppermost materials found in this section are a mixture of topsoil and Made Ground due to the urban nature of Mottram village. Topsoil is found to a depth of 0.5 m and is composed of very soft to soft slightly sandy clay or slightly sandy clayey silt with abundant rootlets. Made Ground thicknesses range from 0.1 m to 2.8 m and is composed of Tarmac and hardcore in the upper layers followed by predominantly fine to coarse sand and gravel including fragments of concrete and brick. Clay is also present and is described as soft to firm, slightly sandy slightly gravelly, occasionally very silty clay with gravel of mixed lithologies. Glacial Till is found beneath the Made Ground/Topsoil and generally thins to the east as the Scheme reaches the edge of a buried palaeochannel. At the western end the Till reaches a depth of approximately 14.5 m to a minimum of approximately 3.5 m at the eastern end of the proposed Mottram Underpass. It is predominantly cohesive with occasional areas of granular material (BH201) and laminated clays (BH43). The cohesive material is described as soft to stiff, slightly sandy occasionally gravelly clay with gravel of mixed lithologies. Granular superficial deposits are described as medium dense, fine to medium, slightly gravelly clayey sand or gravel. The Millstone Grit Group is generally composed of interbedded siltstones and sandstones at the western end of the proposed Mottram Underpass, becoming more mudstone dominated towards the east. This may be due to the faulting in the area, bringing different formations in contact with each other. A significant northwest – southeast trending fault Is present, with evidence of shearing and fault displacements in multiple boreholes.
Eastern Cutting (E)	At the western end of this section, Made Ground is present due to the urban surroundings. The maximum thickness is 2.6 m but generally 1 m of Made Ground is recorded across this area. Moving eastwards this becomes topsoil (2.00 m thickest recorded) as the land becomes more agricultural. The Made Ground consists of mixed material types of sand and gravel with occasional areas of firm clay. Glacial till is identified below the Made Ground/topsoil which increases in thickness moving eastwards, from 1.60 to 4.30 m bgl in the west to 6.00 to 7.00 m bgl in the east. Glacial Till is described as firm to stiff variably sandy variably gravelly Clay. Mudstone bedrock is generally prominent towards the west, with the geological sequence grading towards interbedded sandstone and siltstone to the east.
Longdendale Aqueduct (F)	Topsoil is present (0.40 m thickness) comprising a slightly sandy gravelly Clay. Made Ground is recorded to a maximum depth of 1.60 m

Section of Scheme (Refer to Figure 9.1)	Geology Encountered
	bgl, comprising either a gravelly Sand or a gravelly Clay/Silt. Gravel included brick, pottery and tiles with abundant roots and organic odour. Glacial Till, increases in thickness to the east, from 9.80 m bgl to 20.20 m bgl. Till is described as slightly sandy occasionally gravelly Clay. Bedrock comprises sandstone and siltstone.
Mottram Moor Signal Controlled Junction (G)	Made Ground is present, with thicknesses of up to 2.60 m recorded. Made Ground encountered is associated with the existing A57 embankment and comprised gravel and sand, with gravels of brick and clinker. Topsoil was also recorded to the south of the existing A57, to depths of 0.80 m bgl. Cohesive Glacial Till (slightly sandy occasionally slightly gravelly Clay) underlies the Made Ground/Topsoil to a maximum depth of 23 m. Pockets of granular material have also been recorded in places. Siltstone and mudstone bedrock was encountered from 23 m.
Carrhouse Farm Underpass (H)	Topsoil, comprising slightly gravelly sandy silty Clay was encountered to 0.30 m bgl. Topsoil was underlain by cohesive Glacial Till to depths between 19 and 22 m bgl. No laminated or granular horizons were recorded. Siltstone bedrock was encountered and described as extremely weak.
River Etherow Crossing and Brookfield Junction (I)	Topsoil was recorded to 0.40 m bgl and generally described as sandy silty occasionally gravelly Clay with sporadic gravelly silty clayey Sand Topsoil is underlain by cohesive Head Deposits to 2.50 m bgl, typically described as variably sandy variably gravelly Clay. Cohesive Alluvium was encountered beneath the Head Deposits to depths of between 8.70 m bgl and 10.70 m bgl. Limestone gravel clasts are recorded within the Alluvium. Possible granular Glacio-fluvial deposits were recorded underlying the Alluvial deposits to depths of between 14.30 m bgl and 5.80 m bgl, comprising loose becoming dense, fine to coarse sand and gravel. Bedrock, consisting of mudstone and siltstone was encountered at depths of between 14.30 m bgl and 15.80 m bgl.
Eastern Embankments (J)	Topsoil is present to a depth of 0.40 m bgl, Glacial Till of varying thickness (6.3m in west, 22m in centre of this section and 13.70m at eastern end). Variations in Glacial Till thickness is likely to be due to the presence of previous channels of the River Etherow. The bedrock is dominated by interbedded sandstones and siltstones of approximately 0.5m to 1m thickness, however these have been recorded as between 6m and 8m thick in some sections.

9.6.16 A summary of the chemical testing of soils and groundwater undertaken is provided in Table 9-6. This indicates that potentially elevated concentrations of Dibenz(ah)anthracene and lead were encountered above the Generic Assessment Criteria (GAC) for human health within soil samples analysed. Exceedances of a number of poly-aromatic hydrocarbons (PAHs), total petroleum hydrocarbons and heavy metals were recorded within groundwater samples analysed in comparison to published freshwater Environmental Quality Standards (EQS) and/or UK Drinking Water Standards (DWS).

9.6.17 Asbestos was not recorded in any of the samples analysed from across the entire Scheme, however there is also potential for in-ground asbestos containing

materials to be present. Approximately 11 samples from the 2018 GI were collected from Made Ground across the Scheme.

Table 9-6 Summary of soil and groundwater GAC exceedances from previous phases of GI

Section of Scheme (Refer to Figure 9.1)	Soil - Human Health Exceedances	Groundwater - Controlled Waters Exceedances
M67 Junction 4 to Old Mill Farm Underpass (A)	None recorded	None recorded
Old Mill Farm Underpass (B)	None recorded	None recorded
Western Cutting (C)	None recorded	BH403 – zinc, benzo(a)pyrene, benzo(b)fluoranthene BH404 – benzo(a)pyrene, TPH, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(123)pyrene BH406 - TPH
Mottram Underpass (D)	Dibenz(ah)anthracene exceedance BH411	BH413 - TPH
Eastern Cutting (E)	None recorded	BH418 – zinc, chromium VI BH421 – zinc,
Longdendale Aqueduct (F)	None recorded	None recorded
Mottram Moor Signal Controlled Junction (G)	None recorded	BH422 – zinc, chromium III, TPH
Carrhouse Farm Underpass (H)	None recorded	None recorded
River Etherow Crossing and Brookfield Junction (I)	None recorded	None recorded
Eastern Embankments (J)	Lead exceedance BH427	None recorded
TPH = Total Petroleum Hydrocarbons		

9.6.18 Overall, the GIR (TR010034/APP/7.6) concluded that the two minor exceedances of the GAC for lead and dibenz(ah)anthracene were unlikely to pose an unacceptable risk to human health for the Scheme. Exceedances were considered not representative of “site wide contamination”.

9.6.19 Minor exceedances of the GAC in groundwater were identified. The onsite or offsite source of these exceedances is unknown. It was concluded by GIR (TR010034/APP/7.6) that the concentrations within the overlying Made Ground and Natural Deposits do not indicate a significant source of contamination and do not pose an unacceptable risk to either the Scheme or controlled waters within influencing distance of the site.

9.6.20 As part of the programmed GI in 2021, further soil and groundwater sampling and subsequent analysis have been be undertaken. This will further define ground conditions and identify any potential areas/sources of contamination.

Ground Gas

9.6.21 Ground gas monitoring was undertaken in the following boreholes:

- Western Cutting BH401 and BH406
- Eastern Cutting BH421
- Mottram Moor Signal Controlled Junction BH422.

9.6.22 The Applicant undertook ground gas monitoring on three occasions between 26/06/2018 and 25/07/2018. A “worst case” scenario, informed by readings during low and falling atmospheric pressure, was not achieved on any of the three visits. A summary of the findings of the ground gas monitoring undertaken are presented below:

- Carbon Dioxide concentrations ranged from <0.1 % v/v to 1.3 % v/v
- Methane concentrations ranged from <0.1 % v/v to 0.7 % v/v
- Hydrogen Sulphide was consistently measured below the method detection limit (MDL) of the instrument utilised
- Carbon Monoxide concentrations ranged from <0.1 ppm to 19.0 ppm
- Maximum flow rates ranged from 0.2 l/hr to 4.2 l/hr.

9.6.23 The Applicant concluded that the site could be classified as Characteristic Situation 1 (CS1) in line with guidance provided in CIRIA C665.

9.6.24 The available dataset is limited in terms of ground gas, with no data provided in the areas where confined spaces may be present, in particular the Mottram Underpass. From a review of available information, it is anticipated that ground conditions within the area of the proposed Mottram Underpass are similar to those encountered across the rest of the site, therefore ground gas is not anticipated to pose an unacceptable risk to the Scheme.

9.6.25 As part of the supplementary GI (TR010034/EXAM/9.71), further gas monitoring has been undertaken to aid in the detailed design of the Mottram Underpass.

Further Ground Investigation

9.6.26 A supplementary GI commenced in February 2021 with a 12-week programme (Section 9.5.10-13 provides further details on the supplementary GI). The additional findings from this reporting do not indicate that the supplementary GI differs greatly from those previously recorded from a contaminated land point of view.

Hydrogeology and Hydrology

9.6.27 The geology beneath the site is classified as the following aquifers:

- Devensian Glacial Till and Head deposits: Secondary (undifferentiated)
- Alluvium and River Terrace deposits: Secondary A aquifer
- Bedrock of the Millstone Grit Group (sandstone, siltstone and mudstone): Secondary A Aquifer.

9.6.28 The study area is not within a groundwater Source Protection Zone.

9.6.29 There are no registered Environment Agency groundwater abstractions (licensed) within the study area. There are five private abstractions (recorded by Tameside MBC) from spring, surface and groundwater (borehole) located within the study area and some additional private spring, well and borehole abstractions within a 1 km radius identified through the surface water features survey. The location of these within the study area is shown on Figure 9.1. The closest abstraction is located at Mottram Old Hall, approximately 75 m of the closest red line boundary. According to the Environment Agency's Approach to Groundwater Protection "*All abstractions, including* ***private water supplies****, that are used for drinking water supply or food production purposes* ***are by default in an SPZ1 or SPZ2.".*** It also states that all groundwater abstractions intended for human consumption or food production have a default SPZ1 with a minimum radius of 50 m. However, as the abstraction is located 75 m north of the red line boundary and over 150 m from where any major works are due to be undertaken, this is unlikely to be affected.

9.6.30 The Environment Agency indicates that there are 14 discharge consents to controlled waters within the Scheme, 13 of which are operated by a water company and relate to the sewerage network.

9.6.31 Groundwater was encountered in the superficial and bedrock deposits during the 2018 GI across the Scheme, which also reported the presence of artesian conditions within localised areas. Artesian conditions were present within the Mottram underpass area (BH408, 409 & 413) and within the eastern cuttings (BH417 and BH418). Please refer to the Road Drainage and the Water Environment chapter (Chapter 13) for full details regarding artesian conditions encountered across the Scheme. A summary on the monitored groundwater levels is provided in Table 9-7, which does not include the artesian water conditions.

Table 9-7 Summary of groundwater levels from monitoring

Section of Scheme (Refer to Figure 9.1)	Groundwater Level	
M67 Junction 4 to Old Mill Farm Underpass (A)	Glacial Till: Between 1.00 m bgl (187 m AOD) and 8.00 m bgl (204 m AOD) Bedrock (mudstone and siltstone): Not measured	
Old Mill Farm Underpass (B)	Glacial Till: Ground surface (flooded) Bedrock (mudstone, siltstone and sandstone): Not measured	
Western Cutting (C)	Glacial Till: Not measured Bedrock (alternating sandstone and siltstone): 14.8 m bgl (197.3 m AOD) to 15.30 m bgl (197.7 m AOD)	
Mottram Underpass (D)	West of fault zone Made Ground: <2.0 m bgl (210 m AOD) Glacial Till: Dry Bedrock (alternating sandstone and siltstone): 14 to 15 m bgl (197 m AOD to 198 m AOD)	East of fault zone Glacial Till: 6.00 m bgl (206 m AOD) Bedrock (highly disturbed and weathered mudstones, siltstones and sandstones): 13.00 m bgl to 1.00 m bgl (199 to 213 m AOD).
Eastern Cutting (E)	Granular Glacial Till: Dry Cohesive Glacial Till: Not measured	

Section of Scheme (Refer to Figure 9.1)	Groundwater Level
	Bedrock (siltstone and sandstone): ground level to 6.20 m bgl (210 to 185 m AOD)
Eastern Embankments, Longdendale Aqueduct & Mottram Moor Signal Controlled Junction (F, G & J)	Glacial Till: 1.00 to 16.8 m bgl (121.0 to 105.2 m AOD) Glaciofluvial: 1.00 to 1.20 m bgl (121.0 to 120.8 m AOD) Bedrock (siltstone, mudstone and sandstone): Not measured
Carrhouse Farm Underpass (H)	Glacial Till: Dry Bedrock (siltstone and mudstone): 2.0 to 3.4 m bgl (159.7 to 148.3 m AOD)
River Etherow Crossing and Brookfield Junction (I)	Glacial Till: Not measured Glaciofluvial Deposits: 1.00 to 1.20 m bgl Bedrock (siltstone and mudstone): Not measured

9.6.32 Groundwater flow, using the levels as indicated in Table 9-7 above, was interpreted in the GIR (TR010034/APP/7.6) as follows:

- In the Millstone Grit Group groundwater flow is generally in a south easterly direction towards the River Etherow
- Groundwater west of Mottram in Longdendale Village is considered likely to discharge towards the south-west towards Hurstclough Brook, due to high ground to the south associated with an outcrop of Rossendale Formation (a formation of the Millstone Grit Group)
- A shallower hydraulic gradient is present around the River Etherow at the eastern end of the route. This is likely to be associated with the higher permeability deposits present in this area
- Large changes in groundwater elevation (up to 10 m) have been recorded in the areas of tectonic deformation within Mottram Village.

9.6.33 Based on the GIR (TR010034/APP/7.6) and Groundwater Modelling[43] previously undertaken, it is considered that:

- In the Mottram area, the Till was found to behave as an aquitard inhibiting the upward flow of groundwater originating from the Millstone Grit Group, with groundwater present as discontinuous perched bodies within the Till
- Glacio-fluvial deposits present at the eastern end of the route, within the vicinity of the River Etherow, were found to form a confined water unit sandwiched between the Glacial Till and underlying bedrock
- Where the proposed eastern portal of Mottram Underpass intersects a fault zone within the bedrock, this effectively divides Mottram into two separate groundwater regimes. To the west of the fault groundwater is either absent or below the underpass invert level, hence there is not a need for groundwater control

[43] Arcadis (2017), Detailed groundwater flow modelling for Mottram tunnel. Cdf lot 1 pc 1004 – As14 Phase2 – Options Selection – North West.

- However, artesian or sub-artesian groundwater levels to the east of the fault would need to be controlled by pumping in order to construct the underpass. Movement of groundwater is limited in this area, with a shallow south easterly gradient, commensurate with the spatial distribution of the superficial deposits. The main discharge of groundwater is likely to be to springs via local flow through permeable windows in the Till, or to streams
- Groundwater recharge is low relative to the high regional rainfall.

9.6.34 Surface waters present at the Scheme as referenced above in relation to groundwater flow within the study area as identified within the Road drainage and the water environment chapter (Chapter 13) and on Figure 9-1, comprising:

- The River Etherow (within eastern extent of study area) (WC100)
- Glossop Brook (110 m south east of red line boundary, 515 m south east of River Etherow Crossing) (WC400)
- Hurstclough Brook (30 m south of Hyde Road, at the M67 Junction 4) (WC300)
- Tara Brook (WC200) (approximately 70 m south of the DCO boundary)
- A number of other smaller existing field drains, ponds, areas of spring issues/sinks and unnamed streams indicated within the study area, generally flowing towards the River Etherow.

9.6.35 The United Utilities Longdendale Aqueduct is a major service which the route crosses. Consultation is being undertaken with United Utilities to establish how their assets can be protected and would be considered further at the Detailed Design stage. Due to the lack of identified sources of contamination within the vicinity of the aqueduct, the Longdendale Aqueduct is not considered as a sensitive receptor as part of this assessment. Any potential interaction of the Longdendale Aqueduct with the hydrogeological regime is presented in the Road drainage and the water environment chapter (Chapter 13). There is conflicting information regarding the construction of the aqueduct (whether lined or otherwise). Consultation is being undertaken with United Utilities to confirm the construction of the aqueduct and what potential interaction there might be between the hydrogeological regime present and future.

Historical Development/Potentially Contaminative Land Uses

9.6.36 The earliest maps (circa 1881) show that the Scheme lies within agricultural land with a number of farmsteads and established roads throughout the study area. The town of Mottram is shown to the south, Roe Cross to the north and Hollingworth to the east. Notable features within the study area at this time include a quarry near Roe Cross (250 m north) and Mottram Old Mill (Woollen) with several mills and quarries present within the study area.

9.6.37 In 1910, a small gas works is mapped adjacent to Woolley Lane on the south western edge of Hollingworth (10 m south of red line boundary) and a Bleach Works and associated tanks and Mersey Mills are located adjacent to River Etherow to the east (20 m from red line boundary). Light industry (including Wadding Manufactory) are indicated to the north in Lower Roe Cross.

9.6.38 In 1950, additional industrial activities (Rhodes Mill (disused) and Longdendale (Works)) are shown to the east of the study area near Woolley Bridge near to the

Bleach Works. A sewage works can be seen approximately 300 m to the south of the Scheme in Longdendale.

9.6.39 By 1983, residential development in Mottram and Hollingworth has significantly increased. The industry to the north in Lower Roe Cross is no longer shown. A garage is located in the vicinity of the gas works which is no longer indicated.

9.6.40 Previous GIs along with the supplementary GI have targeted these identified potential sources of contamination.

9.6.41 The site currently comprises a mixture of residential, industrial with significant areas of agricultural and open space land uses with any potential contaminative sources generally being associated with agricultural use.

9.6.42 The Envirocheck Environmental Database indicates there are potentially 40 trade entries in the study area with the majority located to the east in the area of Hollingworth and Hadfield. There is a small cluster of entries associated with Mottram which relate to car dealerships, garage services and blind manufacturers. It also records the presence of six fuel stations within the study area, four are indicated adjacent to the red line boundary of the Scheme.

9.6.43 Environment Agency consultation in 2018 provided a list of pollution incidents within the study area. There are 28 recorded incidents dating between June 2001 and January 2018. For those impacts to Land and Water, the categories were either No Impact (Category 4) or Minor Impact (Category 3) with pollutants involved ranged from firefighting runoff, oils, crude sewage and diesel.

9.6.44 Liaison with Tameside MBC indicated that the Environmental Protection Unit is aware of a single pollution incident taking place within the Scheme boundary since consultation was undertaken in 2018. This involved a diesel spillage due to a road traffic incident, with fuel leaking into soils and possible watercourse. The quantity of fuel leaked was not significant and only localised impacts were anticipated.

Recorded Landfill Sites

9.6.45 Table 9-8 details the landfill sites recorded within the study area as summarised in the GIR (TR010034/APP/7.6).

Table 9-8 Summary of landfill sites within study area

Landfill	Dates	Type of Waste	Distance from Red Line Boundary
Land adjacent to Woolley Lane Gas Works	Nov 1993 – Jan 1996	Inert	Within and adjacent to north eastern Scheme boundary (Mottram Moor junction)
Carrhouse Lane	No information provided	No information provided	Within the Scheme (Carrhouse Farm underpass)
Disused Railway Line	Dec 1990 – Oct 1991	Inert	100m east of Scheme (from River Etherow Crossing/Brookfield junction).

Landfill	Dates	Type of Waste	Distance from Red Line Boundary
Melandra Road Waste Disposal Site	Dec 1977 – Dec 1981	Inert, Industrial, Commercial, Household and Liquid/Sludge	100m south east of Scheme

Land Contamination

9.6.46 Primary guidance for assessing and managing risks posed by land contamination is presented in Land Contamination: Risk Management (LCRM) published by the Environment Agency on 8 October 2020. LCRM provides a technical framework (and signposts other key guidance) for identifying and remediating contamination through the application of a risk management process. The question of whether a risk is unacceptable in any particular case involves not only scientific and technical assessments, but also appropriate criteria by which to judge the risk and conclude exactly what risk would be unacceptable.

9.6.47 A preliminary conceptual site model (PCSM) describes the relationship between potential sources of contamination (resulting from both on and off-site historical and recent activities) and receptors to the potential contamination.

9.6.48 As part of the PCSM development, three elements are identified and assessed:

- Source of contamination and associated contaminants
- Receptors – human beings, controlled waters (surface water/groundwater), ecological systems and property, to that contamination
- Pathways between the sources and receptors.

9.6.49 Where all three elements are present or are likely to be present, they are described as potential contaminant linkages (PCLs), which can then be subjected to the risk assessment and risk management process.

9.6.50 The GIR (TR010034/APP/7.6) produced a summary of the Preliminary Conceptual Site Model produced within the PSSR, identifying the following potential sources of contamination, pathways and receptors.

Table 9-9 Summary of PCSM produced in GIR

Sources*	Pathways	Receptors
Historic landfills Roe Cross Quarry Mottram Woollen Mill Gas works Mill and bleach works; and Sewage works	Direct contact including ingestion or dermal contact with contaminated soils and windblown dust. Surface runoff from disturbed ground. Direct contact or ingestion with contaminated runoff/ groundwater. Inhalation of contamination in dust, vapour or gas.	Human Health including future highways users, general public utilising public open space nearby residents, schools and commercial properties. Controlled waters including superficial deposits, classified as Secondary Undifferentiated and Secondary A Aquifers and the soil geology of Millstone Grit Group classified as a Secondary A Aquifer; and surface water receptors including the River

Sources*	Pathways	Receptors
	Leaching from Made Ground into controlled waters or aquifers. Generation and migration of ground gas and vapours via permeable strata or preferential pathways along engineered structures (services or piles).	Etherow, Hurtsclough Brook, ponds and drainage channels.

*All sources are indicated to be outside of the red line boundary

9.6.51 Following the completion of the GQRA and preliminary waste classification the following conclusions regarding pollutant linkages were drawn:

- Two minor exceedances for Lead and Dibenz(ah)anthracene were recorded within soils when analysed against the public open space (residential) generic assessment criteria. This appears to be localised contamination and not site-wide. No asbestos was detected in the soils samples tested. As the Scheme would mostly comprise hardstanding and/or vegetation, it is considered that this is sufficient to sever any potential pathway. Based on these results a significant risk to human health is not anticipated.
- Minor groundwater exceedances have been identified along the entire route. It is unknown whether the overlying Made Ground or an offsite source of contamination is the source of the elevated concentrations in the groundwater samples. Elevated concentrations of metals, PAHs & TPH are considered to be minor and therefore are unlikely to pose an unacceptable to either the Scheme or controlled waters within close vicinity of the site. Where materials are to be re-used onsite, consideration should be given to protection of surface waters from leachable heavy metals and further assessment may be required to verify that soils a suitable for reuse.
- The limited available data indicates that the potential risk of ground gas is considered to be low. However, given the potential landfill sources and the proposed confined spaces there may be an acute risk to construction / maintenance workers within the area of BH404. Further ground gas monitoring has been undertaken as part of the supplementary GI to further assess the risk from ground gases associated with the Scheme.
- Based on initial soil analysis results, materials are likely to be chemically suitable for reuse on the Scheme, subject to further detailed design taking into account the proposed use of the material. An MMP or environmental permit would be required to legally re-use soils on the Scheme. The majority of excavated onsite materials, if in excess to re-use requirements, are likely to be classed as non-hazardous with a portion being likely suitable for classification as inert, subject to the results of WAC testing.

Agricultural soils

9.6.52 The only published soil map of the area around Mottram is the 1:250,000 scale *Sheet 1 Northern England* of the National Soil Map[10]. The soils are described in the accompanying book, *Soils and their Use in Northern England*[11].

9.6.53 Soils of the study area are mostly developed in heavy textured Glacial Till with Alluvium on the floodplain of the River Etherow.

9.6.54 Three soil associations (recurring groupings of soils within similar landscapes) are mapped within the study area.

9.6.55 The Wilcocks association occupies the western part of the study area between the M67 Junction 4 and Carrhouse Lane. These naturally acid soils have a peaty surface over heavy clay loam over clay and are waterlogged for long periods.

9.6.56 East of Carrhouse Lane there is the Brickfield association whose soils are similar to the Wilcocks but lack a peaty topsoil.

9.6.57 On the floodplain of the River Etherow there are clay loam soils of the Enborne association affected by a high water table and flooding.

9.6.58 The areas of soils with and without a peaty surface and those in alluvium are shown in Figure 9.2 (TR010034/APP/6.4) in the extract from the LandIs Soilscapes Viewer[42.]

Agricultural land classification

9.6.59 The only published map of land quality is MAFF's Provisional Agricultural Land Classification (ALC) map of North West England[38]. This shows, in Figure 9.3 (TR010034/APP/6.4), all the study area to be Grade 4 (poor quality land). There is some Grade 3 (good to moderate) west of the M67 Junction 4 and Grade 5 (very poor quality) on the moors to the north and east. This indicates that, in its regional context, the land in the study area has no special agricultural value.

9.6.60 The 1988 MAFF issued Revised guidelines and criteria for grading the quality of agricultural land[39]. These guidelines provide detailed parameters for identifying the factors limiting agricultural land quality and also provide a method for subdividing Grade 3 into Subgrades 3a and 3b. Natural England and the National Planning Policy Framework class land in Grades 3a and better as BMV and requiring protection from development. DMRB LA109 assigns high and very high values to such land and a loss of more than 1ha is assessed as a significant adverse effect.

9.6.61 The factors relevant to the revised ALC guidelines in the study area relate to a combination of climate, soil texture and wetness. Additionally, land beside the River Etherow has a flood risk.

9.6.62 The local climate, at an altitude of 180 m OD, is wet, with an average annual rainfall of 1032 mm and 236 field capacity days (when the soil is replete with moisture, after surplus water has drained out through gravity).

9.6.63 Topsoil textures, except on the floodplain are heavy clay loam or clay, and peaty in the western part. Subsoils are dense and slowly permeable, producing a perched water table. The soils of the floodplain are medium or heavy clay loams, but more permeable than those in the Till and affected by a high groundwater table.

9.6.64 Soil wetness is expressed by a Wetness Class (WC) which reflects the period of waterlogging within 40 cm and 70 cm of the surface in most years. Brickfield and Enborne soils are in WC IV, indicating they are likely to be wet within 40cm for up to 180 days. Wilcock soils are in WC IV to V, and likely to be wet within 40cm for more than 180 days.

9.6.65 The application of these parameters to the revised ALC guidelines means that none of the study area can be better than Grade 4 and some of the Wilcocks

soils may be in Grade 5. Improved grassland cut for silage can be seen on recent and historic Google Earth imagery in the vicinity of Carrhouse Lane, supporting the likelihood that the Brickfield soils are marginally better than the others.

9.6.66 Natural England is not required to be a consultee for developments on these low grades of land.

Future Baseline

9.6.67 A PSSR, previous GIs and GIR (TR010034/APP/7.6) are available which provide significant baseline information for the Scheme, extracts as summarised above provide the preliminary baseline; however, due to the design and guidance changes since this time, further baseline information has been collected. Following the supplementary GI in 2021, this additional information will inform the Scheme's Detailed Design stage. This investigation has been be designed to:

- Further assess the presence or confirm absence of land and groundwater impacted with contamination (including ground gases), where previous GI data is not available and to support the Scheme design
- Provide further chemical analysis of soils to determine their suitability in areas where these are proposed to be reused
- Further determine the hydrogeological conditions, specifically associated with the proposed Mottram Underpass and Eastern Portal Cutting for design purposes.

9.6.68 A GIR, in accordance with DMRB CD 622 Managing geotechnical risk has been submitted for the DCO exam as the Supplementary Ground Investigation Report (TR010034/EXAM/9.71) in a standalone document in March 2022. This includes a revised contaminated land generic quantitative risk assessment in accordance with current guidance (Environment Agency LCRM) pertaining to the historic and supplementary GI data. This report also assesses the risks associated with land stability and mining hazards. It is considered that there has been sufficient information to complete the assessment and the supplementary GI does not differ greatly from the finding previously recorded from a contaminated land point of view.

9.6.69 A Materials Management Plan (MMP) supported by a remediation strategy would be included within EMP (Second iteration) (TR010034/APP/7.2) and implemented to enable the legal reuse of soils under the CL:AIRE Definition of Waste Code of Practice (refer to the Material assets and waste chapter (Chapter 10). It is envisaged that the majority of site won soils would be reused in the Scheme with some required stabilisation for engineering purposes and/or import of suitable engineered soils.

9.6.70 The combination of climatic, soil and other factors gives a high level of confidence that there is no BMV land in the study area and so a detailed soil/ALC survey is not required.

9.6.71 It is understood that particular aspects of the groundwater regime likely require further assessment during detailed design. These include:

a) The means of controlling groundwater during construction [Mottram Underpass]

b) The effects of dewatering on existing structures, particularly settlement during construction and operation of the underpass [Mottram Underpass and Cutting]; and

c) Impacts of dewatering (both short and long-term) on the hydrological/ hydrogeological regime in both the superficial deposits and bedrock [Underpass and Cutting].

9.6.72 Further works would be undertaken during detailed design, as detailed in the Road drainage and water environment chapter (Chapter 13), to quantify the degree of interaction between groundwater and nearby identified surface water features (e.g. springs/streams) and Longdendale Aqueduct, and where necessary, inform the design of solutions such as non-uniform depth secant piles to mitigate potential impacts post-construction.

9.6.73 It is not considered that the geology baseline would be significantly altered during the construction of the Scheme. Geology within the cutting would be exposed along with the sustainable reuse of natural soils across the Scheme. No further alterations are anticipated.

9.7 Potential Impacts

9.7.1 From the baseline, the receptors identified through this assessment have been assigned the following value/sensitivity.

Table 9-10 Summary of receptors and assigned value/sensitivity for geology and soils

Receptor	Value/Sensitivity
Geology	Low
Soils to Human Health • Highways land use (future) • Public open space utilised by local residents • Residential housing and schools • Local Business/commercial properties	 • Low • High • Very High • Medium
Soil Resources - Agricultural Soils	Low
Groundwater Quality (including that used by private abstractions)	Medium (please refer to Chapter 13 for sensitivity justification)
Surface Water Quality (including that used by private abstractions)	Medium (please refer to Chapter 13 for sensitivity justification)
Hydrogeological regime (Secondary aquifer used for local supplies (5 private abstractions), supplying base flow to surface water features.)	Medium (please refer to Chapter 13 sensitivity justification)

9.7.2 Local residents utilising public open space have been assigned a high sensitivity due to the nature of the works being undertaken across the Scheme, and due to the lack of identified sources within the areas where works are due to be undertaken.

9.7.3 Potential impacts that could occur to these receptors associated with the Scheme have been identified as:

- Spread or mobilise pre-existing (historic land use) contamination across the Scheme impacted on overall land quality
- Pollution due to construction or future activities (storage of fuels, spillages etc)
- Exposure to adjacent residents associated with dust migration during earthworks
- Exposure to contaminated soil, ground gas mitigation into confined spaces or groundwater contamination for the future end use
- Migration of contamination through creation of preferential pathways (including piling), surface water run-off (and migration into aquifer) and dewatering (and in turn to surface waters)
- Exposure to contaminated surface and groundwater abstracted for use locally
- Impact on hydrogeological regime though creation of cuttings
- Loss of non BMV agricultural land.

9.7.4 The most sensitive receptors have been identified as local residents, including schools, within a 250 m radius of the Scheme and local private water abstractions within a 1 km radius of the Scheme. These are shown on Figure 9-1 (TR010034/APP/6.4).

9.7.5 Once the commissioning activities have taken place the Scheme would be open to traffic. There would be an initial 5-year maintenance period for any construction defects that arise after commissioning and opening, as well as management of environmental landscaping and planting. Most impacts would occur in the construction phase and there would be few additional impacts during operation. The latter would be limited to an initial 52-week aftercare period in land restored to agriculture, during which time problems with settlement, compaction, surface stoniness and drainage would be rectified by the appointed Principal Contractor.

9.7.6 After this period the Scheme would be handed over and maintained based on the type of land acquisition as follows:

- Outright acquisition in which the land would be handed over to the various asset owners who operate the road and public rights of way network (Highways England, Tameside MBC and Derbyshire County Council) for future maintenance operations
- Temporary possession, where the land would be returned to its original owners and restored to a condition equivalent to its original in agreement with landowners. When the land is classed as temporary acquisition with permanent third-party rights, the land would be returned back to its original owner, as above, with access rights identified and arranged with individual landowners.

9.7.7 A programme of monitoring visits and reports would be carried out as part of the on-going maintenance requirement. Remedial operations identified by the monitoring required to ensure the success of the planting and management proposals would be carried out as part of the on-going maintenance requirement.

9.7.8 In the construction phase around 24 ha of agricultural would be permanently acquired and 8.3 ha would be occupied temporarily for construction works. A further 2 ha of land would be lowered to create a flood compensation area beside the River Etherow.

9.7.9 Designated geological sites have not been identified; however, local geology may be exposure through cutting which could provide a local benefit under DMRB LA109.

9.8 Design, Mitigation and Enhancement Measures

Embedded mitigation

9.8.1 The Scheme has been designed, as far as possible, to avoid and minimise impacts and effects on the geology and soils environment through the process of design development. Environmental design measures considered to be integral to the Scheme are included in the Scheme chapter (Chapter 2). These are summarised below:

- As outlined in the CL:AIRE Definition of Waste Code of Practice (DoW CoP), the sustainable reuse of soils should be implemented through good practice as set out in DEFRA's "Construction Code of Practice for the Sustainable Use of Soils on Construction Sites". This involves the production of a Soil Resource Plan (SRP), MMP and a Site Waste Management Plan (SWMP). Sustainable reuse of soils BS ISO 18504 published in 2017 or BS ISO 15176: 2019 Soil quality – Guidance on characterization of excavated soil and other materials intended for re-use.
- The First iteration Environmental Management Plan (EMP) (TR010034/APP/7.2) provides clear and concise information which states how the mitigation and management of environmental effects would be delivered and maintained. This would include, but is not limited to, construction activities, stockpile management, emergency procedures, records of environmental incidents, environmental monitoring, etc.
- A piling risk assessment (PRA) would ensure that the selected piling methods associated with the new structures does not introduce contamination pathways into the aquifer underlying the Scheme.
- Hydrogeological risk assessment would be undertaken to inform the detailed design for works associated with Mottram Underpass and cutting, including mitigation measures.

9.8.2 Based on the limited potential for geologically important sites being present, it is not considered that there would be a significant impact on the any statutory and non-statutory designated sites, therefore mitigation is not deemed necessary for this.

Essential mitigation

Agricultural soils

9.8.3 None of the affected land is of BMV quality, or significantly better than any other in the study area, so there is no need for the design to be modified to avoid land-take in any particular area of soils.

9.8.4 The 8.3 ha temporarily acquired for construction shall be restored to a condition equivalent to its original, following the 52-week aftercare period. This shall be achieved by means of a Soil Resource Plan following the best practice set out in Defra's *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*[13].

9.8.5 There is no mitigation for the permanent loss of agricultural soils, apart from conserving the soils that are stripped and using them elsewhere on the Scheme.

9.8.6 A soil management specialist shall be employed by the contractor to ensure soils being stripped, stockpiled and restored are handled correctly.

9.8.7 On the flood compensation area beside the River Etherow, the topsoil shall be stripped and stockpiled before being replaced on the lowered ground surface. The resulting quality of this land due to the lowered ground surface would be poorer than before as a result of changes to the soil profile and increased flood risk; the ALC grade being reduced from Grade 4 to Grade 5, making it suitable only for rough grazing and hay making.

Potential Enhancements

9.8.8 The creation of the Mottram Underpass would provide an opportunity to create a geological benefit associated with the visual exposure of local geology within the cutting. It is envisaged that the cutting may become an asset to the visual landscape which can be seen on journeys through the area. Any geology exposed from the creation of the underpass would be recorded and may be utilised for a learning opportunity (e.g. recorded online).

9.9 Assessment of Likely Significant Effects

9.9.1 The Scheme lies mainly within a rural setting with the villages of Mottram, Hollingworth and Roe Cross within the vicinity. A number of private water abstractions are held within a 1 km study area.

9.9.2 The published and encountered geology generally correspond and include superficial deposits of Till, Alluvium and River Terrace Deposits over bedrock from the Millstone Grit Group. Made Ground was also encountered in localised areas associated with previous developments.

9.9.3 An intrusive investigation has been undertaken previously to further classify land quality and identify any mitigation measures which may be required. No significant contamination sources have been identified from chemical testing undertaken for the Scheme.

9.9.4 Closed landfills are present within the Scheme; however, none are considered to pose an impact to the Scheme, due to nature of material accepted, age of infilling and the proposed works associated with the Scheme.

9.9.5 A summary of the identified receptors and potential impacts are provided in Table 9-11 below.

Table 9-11 Summary of Identified Receptors and Potential Magnitude of Impact

Receptor (Sensitivity)	Effect during Construction	Effect during Operation	Mitigation	Magnitude of Impact (construction)	Magnitude of Impact (operation)	Significance of effect
Geology/Soils including land quality and soil resources (low)	Spread or mobilise pre-existing (historic land use) contamination across the Scheme impacting on overall land quality	Continued mobilisation of pre-existing (historic land use) contamination with the potential to impact on overall land quality	GI and contaminated land risk assessment to inform the design process including assessment of ecological receptors. Reuse of soils under appropriate guidance and documentation (e.g. CL:AIRE Definition of Waste Code of Practice and EMP in accordance with DMRB LA 120)	The geology in the area is considered to be of low value. Following mitigation, the magnitude of impact is considered to be **negligible**. This would result in a **neutral or slight adverse** (temporary) effect.	As part of the Scheme, there is a deep cutting to create the Mottram Underpass. Any geology exposed from the creation of the structure would be recorded and may be utilised for a learning opportunity. The geology is considered to be of low value/sensitivity and the magnitude of impact is considered to be **minor beneficial**. This would result in a **neutral or slight adverse** (permanent) effect.	**Construction** Overall, the scheme is considered to have a neutral or slight adverse (temporary) effect, resulting in a **non-significant** classification. **Operation** Overall, the scheme is considered to have a neutral or slight adverse (permanent) effect, resulting in a **non-significant** classification.
	Pollution due to site activities (storage of fuels, spillages etc)	Pollution due to operational activities (run off to land etc)	Standard construction best practice including stockpile management Drainage design to ensure runoff does not impact on land quality			
Human Health • Highways land use (low) • Public open space utilised by local residents near by the Scheme (high) • Residential properties and schools (very high) • Business/commercial properties (medium)	Exposure of adjacent residents to dust migrating off-site during earthworks	Minimal exposure of road users to contaminated soil/ground gas migration into confined spaces in the future end use.	Contaminated land risk assessment to inform the design process. Standard construction best practice including stockpile management, mitigation measures as appropriate for end use as per those outlined in Table 2-5 in the Scheme chapter (Chapter 2).	Residents utilising public open space are considered to be of high value/sensitivity. With mitigation measures applied, the magnitude of impact would be **negligible**. This would result in a **slight adverse** (temporary) effect. Residents dwelling in residential properties within close vicinity of the proposed works (including those with private water abstractions) and local schools are considered to be of very high sensitivity. With mitigation measures applied, the magnitude of impact would be **negligible**. This would result in a **slight adverse** (temporary) effect). Business/commercial properties within 250 m of the scheme are considered to be of medium sensitivity. Following mitigation, the magnitude of impact is considered to be **negligible.** This would result in a **neutral or slight adverse** (temporary) effect.	Highways users are considered to be of low value/sensitivity due to limited (if any) exposure to soils. With mitigation the magnitude of impact is considered to be **negligible adverse**. This would result in a **neutral** (permanent) effect. Residents utilising public open space surrounding the highway during operation are considered to be of high value/sensitivity. With mitigation measures applied, the magnitude of impact would be **negligible**. This would result in a **slight adverse** (permanent) effect. Residents are considered to be very high sensitivity in relation to local water abstractions. With mitigation the magnitude of impact is considered to be **negligible adverse**. This would result in a **slight adverse** (permanent) effect. Business/commercial properties within 250 m of the scheme are considered to be of medium sensitivity. Following mitigation, the magnitude of impact is considered to be **negligible.** This would result in a **neutral or slight adverse** (permanent) effect.	**Construction** Overall, the scheme is considered to have a slight adverse (temporary) effect, resulting in a **non-significant** classification. **Operation** Overall, the scheme is considered to have a neutral or slight adverse (permanent) effect, resulting in a **non-significant** classification.
	Contaminants mobilised during construction - residents exposed to contaminated groundwater via abstractions	Continued impact on water quality	GI and contaminated land risk assessment to inform the design process. Mitigation measures as appropriate as per those outlined in Table 2-5 in the Scheme chapter (Chapter 2).			
Groundwater/Surface Water Quality	Migration of contamination through creation of preferential pathways, surface water run-off (and migration info aquifer) and dewatering (and in turn to surface waters)	Impact on water quality via preferential pathways (e.g. piling)	Supplementary GIR (TR010034/EXAM/9.71) will be used to inform a subsequent contaminated land risk assessment, including a piling risk assessment at the Detailed Design stage. A Hydrogeological Risk Assessment is presented in Appendix 13.2 (TR010034/EXAM/9.43), has been undertaken, which will also inform the detailed design. Appropriate pollution prevention measures as per those outlined in	Surface water and groundwater within the Scheme is considered to be of medium value as it is a Secondary Aquifer. With mitigation the magnitude of impact would be **negligible**. This would result in a **neutral** (temporary) effect.	During operation there is the potential of contamination from pollution incidents (fuel spills) and road spray. The water environment may be exposed during such incidents. The receptors are considered to be of medium value/sensitivity. With the implementation of appropriate mitigation measures (drainage design/strategy) the magnitude of impact is considered to be **negligible adverse**. This would result in a **neutral** (permanent) effect.	**Construction** Overall, the scheme is considered to have a neutral (temporary) effect, resulting in a **non-significant** classification. **Operation** Overall, the scheme is considered to have a neutral (permanent) effect, resulting in a **non-significant** classification.

Receptor (Sensitivity)	Effect during Construction	Effect during Operation	Mitigation	Magnitude of Impact (construction)	Magnitude of Impact (operation)	Significance of effect
			Table 2-5 in the Scheme chapter (Chapter 2 and within relevant guidance documentation.			
Hydrogeological regime (Manchester and East Cheshire Carboniferous Aquifers)	Impact on hydrogeological regime though creation of cuttings	Impact on hydrogeological regime though creation of cuttings	Where piling is planned, a piling risk assessment would be carried out to ensure the selected piling method does not introduce contamination pathways into the aquifer. A Hydrogeological Risk Assessment is presented in Appendix 13.2 (TR010034/EXAM/9.43), following completion of additional GI, to assess the hydrogeological regime, and aid determination of appropriate mitigation measures such as secant piling during construction of cuttings to prevent dewatering effects reducing baseflow to surface water features or affecting private water supplies. King pin piling could be used if groundwater flow is perpendicular to the cutting. Drainage would be designed to account for groundwater flows as well as surface water.	With mitigation the magnitude of impact would be **minor adverse** as detailed in the Road Drainage and Water Environment chapter, Chapter 13.	With mitigation the magnitude of impact would be **minor adverse** as detailed in the Road Drainage and Water Environment chapter, Chapter 13.	**Construction** Overall, the scheme is considered to have a slight adverse (temporary) effect, resulting in a **non-significant** classification. **Operation** Overall, the scheme is considered to have a neutral or slight adverse (permanent) effect, resulting in **a non-significant** classification.
Soil Resources - Agricultural Soils (low)	Loss of non BMV agricultural land	None	Restore agricultural land temporarily acquired utilised for construction compounds/access to its original condition and return to farming. There is no environmental mitigation for permanent loss of agricultural land.	Permanent land take - Land in ALC Grades 4 and 5 is assigned a low value in the DMRB guidelines, but physical removal or permanent sealing of >20ha of agricultural soils is an impact of **major** magnitude. The significance of effect of this land-take on soils in Grades 4 and 5 (low value) is assessed as **slight adverse** (permanent**)**, which is not significant.	Temporary land take - When the land temporarily acquired for construction is restored to its original condition, the effect would be **negligible**. Flood compensation area - This land would be of poorer quality, but it is already in Grade 4, and so the effect is assessed as only **slight adverse** (permanent), which is not significant.	**Construction** Overall, the scheme is considered to have a slight adverse (permanent) effect, resulting in a **non-significant** classification. **Operation** Overall, the scheme is considered to have a slight adverse (permanent) effect, resulting in a **non-significant** classification.

9.9.6 The significance of effect has been assessed in line with the guidance presented within Chapter 4, in compliance with DMRB.

9.9.7 Overall, with mitigation, all residual impacts (during both construction and operation) on geology and soils are considered to be not significant in terms of the EIA Regulations 2017.

9.9.8 During construction, all effects are considered to be temporary with the exception of the permanent land take impacting agricultural soils. Magnitudes of impact range from negligible to major, however, all have been classified as non-significant due to the low sensitivity of the identified soil resources receptors associated with the major effect.

9.9.9 During operation effects associated with geology are considered to be permanent, while the remaining other effects identified are temporary. The permanent impact on the geology is considered to have a slight beneficial rating and is associated with creating a geological exposure outcrop within the cutting. The exposure of geology within the cutting may create a potential learning opportunity where the geology encountered can be recorded. Overall, all have been classified as non-significant in relation to the significance of effect.

9.9.10 At Detailed Design stage the further GI assessment will also ensure that the design required for the creation of cuttings and the earthworks proposed would aid in the design of mitigation measures, which would reduce any significant impact in relation to the hydrogeological regime and the suitability and sustainability of the reuse of soils.

Agricultural soils

Permanent land-take

9.9.11 Land in ALC Grades 4 and 5 is assigned a low value in the DMRB guidelines, but physical removal or permanent sealing of >20ha of agricultural soils is an impact of major magnitude.

9.9.12 The effect of this land-take on soils in Grades 4 and 5 (low value) is assessed as slight adverse, which is not significant.

9.9.13 There would be no further effects on agricultural soils in the operation phase.

Temporary land-take

9.9.14 When the land temporarily acquired for construction is restored to its original condition, the effect would be neutral.

Flood compensation area

9.9.15 This land would be of poorer quality due to its future use, but it is already in Grade 4, and so the effect is assessed as only slight adverse, which is not significant.

Overall significance of effect on agricultural soils

9.9.16 No effects are greater than slight adverse and so the overall effect of the Scheme on agricultural soils is not significant.

9.10 National Policy Statement for National Networks (NPS NN) compliance

9.10.1 The table below provides a demonstration on how the assessment undertaken as part of this chapter has complied with the guidelines presented within the NPS NN in relation to Geology and soils.

Table 9-12 Summary of NPS NN Compliance

NPS NN Guidelines	How it has been actioned in this chapter
Pollution control and other environmental protection regimes	A review of the environmental and historical setting of the site has been undertaken to identify potential sources of contamination which may pose an unacceptable risk to identified receptors during the construction/operation of the scheme. Preliminary consultation has been undertaken with the Environment Agency and Local Authorities. A Conceptual Site Model highlighting the key sources, pathways and receptors has been presented in accordance with current LCRM guidance. GI data from previous phases of GI have been reviewed, identifying areas where contamination may be present. Further GI is programmed to help refine and obtain more detail regarding ground conditions. Following completion of the further GI and revision of risk assessments and CSM, if unacceptable risks are identified then remediation/mitigation measures would be proposed.
Biodiversity and ecological conservation which includes geological conservation;	Please refer to Chapter 8 for assessment on Biodiversity. The Tameside MBC RIGS officer was consulted as part of this assessment; however, no response was received at the time of writing. As part of the Scheme, there is a deep cutting to create the Mottram Underpass. This would expose the bedrock geology and it is planned to keep some of the bedrock exposed, resulting in a slight beneficial impact.
Waste Management	Please refer to Chapter 10 for details regarding waste management.
Land Stability	Land stability associated with geological conditions and mining hazards are assessed though guidance CD622 Managing Geotechnical Risk under the Development Control Order (DCO) and are not assessed in terms of environmental impact in accordance with DMRB LA109.
Water quality and resources including physical characteristics of the water environment plus quantity and dynamics of flow	Consultation was undertaken with the Environment Agency and Local Authorities regarding details on private abstraction licences. Groundwater features within 1 km of the site have been identified and included within the assessment along with surface water features within 250 m. Please refer to Chapter 13 for details on assessment pertaining to water quality, water resources and physical characteristics.
Land use including open space, green infrastructure and Green Belt	A review of MAFF's Provisional ALC map of North West England has been undertaken along with a review of the study areas climate, soil texture and wetness, indicating that the none of the study area can be better than Grade 4 or Grade 5 in some cases.

(Agricultural Land Classification, soil quality and consideration of the risk posed by land contamination and how it is proposed to address this.)	The magnitude of impact on this change in land use has been assessed as being slight adverse. Further GI has gathered further environmental soil samples to assess the potential levels of contamination present within soils. A comparison of the soil text data gathered against relevant generic assessment criteria will be undertaken to inform the detailed design, in addition to that already completed to inform soil re-use assessments.

9.11 Monitoring

9.11.1 Verification testing and reporting would be required for the project throughout construction and as part of the planning process to assess/reduce any potential operational effects.

9.11.2 The First iteration EMP (TR010034/APP/7.2) would aim to limit any potential effects that arise from construction including the following relevant to geology and soils:

- Environmental method statements including stockpiling and reuse of soils
- Emergency procedures and records of any environmental incidents
- Environmental and monitoring reports.

9.11.3 In line with the CL:AIRE DoW CoP a MMP would also be required along with a verification plan. The MMP must be produced prior to any excavation taking place on site and provides descriptions of materials to be used and tracking of material movements. All materials subject to excavation, disposal, treatment and/or reuse must be tracked throughout, and evidence generated to provide an auditable trail.

Agricultural soils

9.11.4 The land acquired temporarily and restored to farming shall be monitored during a 52-week period of aftercare, during which time problems with compaction, surface stones, drainage and settlement shall be rectified.

9.12 Summary

9.12.1 Overall, baseline conditions have not identified any significant potential sources of contamination or sites of geological interest. GIs have been undertaken across the scheme with a supplementary GI undertaken to further refine ground conditions across the Scheme and aid in the design process.

9.12.2 In summary the Scheme is deemed to have the following effects:

- Geology and soils – neutral or slight temporary effect during construction and a neutral or slight permanent effect during operation
- Human Health – slight adverse temporary effect during construction and a neutral or slight temporary effect during operation
- Groundwater/Surface Water Quality – neutral temporary effect during construction and operation

- Hydrogeological Regime –minor adverse temporary effect during construction and a neutral/minor adverse temporary effect during operation.
- Soil Resources – slight adverse permanent effect during both construction and operation.

9.12.3 All effects due to the Scheme are considered to be non-significant.

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